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# Effect of some Chemical Herbicides on growth and yield characteristics for two bread wheat cultivars *Triticum aestivum* L.

Dheyaa Fathi Aljuburi[1] & Moyassar Muhammad aziz[2]
[1,2] Department of Field Crops - College of Agriculture and Forestry - University of Mosul - Mosul – Iraq.
Dheyaa Fathi Aljuburi: dfhrdheyaa@uomosul.edu.iq

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ABSTRACT

Bread-Wheat (*Triticum aestivum* L.) ranks among the world's most essential food crops, particularly within the grain category. Its yield potential can be significantly enhanced through the use of high-yield cultivars, alongside optimal fertilizer application, irrigation, and herbicide usage. Accordingly, a field experiment was carried out during the 2021-2022 growing season at two locations in Nineveh Governorate: Bartella and Tilkaif. These semi-arid regions depend on supplementary irrigation. The experiment focused on two main factors: chemical herbicides (Control, Atlants, Pallas, Reward, Spotlight, Spotlight+Clodia, and Spotlight+Reward) and wheat cultivars (Wafia and Tal Afar3).

The experiment conducted using a strip-block design within a randomized Complete Block Design (RCBD) with three replications. Data analyzed using the Least Significant Difference (lsd) test for comparing means. The results showed that the combined herbicide treatment of Spotlight+Reward significantly improved plant height, number of spikes/m2, weight of 1000 grains (g), and grain yield (g/m²), with values of 80.453 and 85.8 cm, 333.6 and 321.667 spikes/m², 35.024 and 34.517 g, and 312.93 and 214.214 g/m² at Tilkaif and Bartella, respectively. The Wafia cultivar achieved the peak value yield in terms of spikes number at square meter and grain yield (g/m²), with values of 319.543 and 308.155 spikes/m² and 234.946 and 214.214 g/m² at Tilkaif and Bartella, respectively.
Based on the aforementioned findings, we conclude that the combination of herbicides (Spotlight + Reward) beside "Wafia" cultivar played a significant role in suppressing weed growth, in addition to causing a substantial increase in yield traits and its components.

KEYWORDS
Bread-Wheat, Herbicide, Cultivars, Weeds, Pallas, Spotlight.

## 1. Introduction

Wheat (*Triticum aestivum* L.) is a globally abundant food crop, belonging to *Poaceae* family. Yield improvements can be up to 11 times greater with high-yield cultivars, optimal fertilizer use, irrigation, and herbicides (Wahab & Aljuburi, 2023).

As the global population grows, the Food and Agriculture Organization (FAO) estimates the world population will hit nine billion by 2050. This increase will require doubling crop production to meet future food demands (FAO, 2020). Global statistics report that grain production worldwide in the 2023/2024 season reached about 784.91 million metric tons (ASGIS, 2024).

Though Iraq is among the original regions where wheat originated and has suitable conditions for its cultivation, its production rate is still low compared to global figures. Statistics show that the total area planted with wheat in the winter season of 2023 was 8,420,000 dunams, a 12.5% increase from the 2022 season, which had 7,487,000 dunams. In 2023, Iraq produced 4,248,000 tons of wheat, a 53.6% increase from 2022, when 2,750,000 tons were harvested. The average yield per dunam in the winter of 2023 was estimated at 504.5 kg, a 36.6% increase from 2022's 369.3 kg (ASGIS, 2023).

Weeds significantly impact agricultural production by reducing crop yield worldwide (Anthimidou *et al.*, 2020). They lower crop quality and quantity and pose health risks to humans and animals by competing for light, nutrients, soil moisture, and space. One reason for Iraq's low wheat production is the lack of scientific methods in wheat cultivation and management, especially weed control. This results in yield losses of 30-50%, as weeds are a limiting factor for wheat growth and productivity (Halawa, 2019). Increased weed density in a unit area leads to reduced crop yield due to decreased plant biological efficiency (Galon *et al.*, 2019).

Herbicides are highly effective tools for weed control and reducing crop yield losses (Heap, 2019). Chemical control is preferred over traditional methods due to ease of use, low cost, and rapid effectiveness in eliminating weeds and reducing their impact on crop growth and yield (Matzrafi *et al.*, 2017). Nevertheless, repeatedly using the same herbicide at incorrect concentrations may result in weed resistance. Effective control and prevention of weed resistance can be achieved through herbicide mixtures, which require lower concentrations, have a broad spectrum, and increase effectiveness on target weeds without harming the crop (Patel *et al.*, 2017).

Weeds are not the only factor affecting crop yield; other factors include nutrients and crop cultivars. Choosing the most suitable cultivar for the prevailing environmental conditions, which has high weed competitiveness, helps increase production per unit area. Newly introduced wheat genetic cultivars have shown good performance under irrigated conditions in Iraq, as demonstrated through trials comparing their performance with approved cultivars, encouraging their adoption for cultivation in these areas (Mansoor, 2021).

## 2. Materials and Methods

A field-experiment conducted during the growing season (2021-2022), at locations “Bartella “ and “Talkaif “ within Nineveh Governorate, both of them within semi-arid regions relying on supplementary irrigation. The experiment included two factors: the first being chemical herbicides (1- Control, 2- Atlants, 3- Pallas, 4- Reward, 5- Spotlight, 6- Spotlight+Clodia, 7- Spotlight+Reward) and the second being wheat cultivars (Wafia and Tal-Afar3).

### *2.1. Agricultural Operations*

The felid was prepared by plowing twice orthogonally using a moldboard plow, and the soil was then refined using disk harrows. Sowing was performed using a seed drill on November 26th, 2022. The fertilizer (diammonium phosphate, "DAP") added in a single dose at sowing stage with a rate (200 kg/ha), following the recommendations of Iraqi Ministry of Agriculture. Nitrogen fertilizer (urea, containing 46% N) was divided in two amounts (120 kg/ha at tillering stage and 120 kg/ha at elongation stage).

### *2.2. Experimental Design*

The experiment was implemented following a strip-block design within a randomized complete block design (RCBD) with three replications. Each replication contained 14 experimental units, totaling 42 experimental units. columns included the chemical herbicides, while rows included the wheat cultivars. Analysis was performed using (lsd) test to compare means, utilizing GenStat V12 software.

**Table (1) Herbicide information.**

| Commercial Name | Active substance | Chemical Group | Recommendation Rate | Target Weeds |
|---|---|---|---|---|
| Reward-Max EC | Clodinflop-propagyl 24% w/v. Cloquintocet-Mexyl 6%. w/v | Aryloxyphenoxy-propionates | 600 ml/ha. | Narrow-leaved weeds |
| Spotlight 75% DWG | Tribenuron-methyl 75% | Sullfonylurea | 80 g/ha. | Broad-leaved weeds |
| Atlants | Mesosulfuron Methyl 10 g/l Iodosulfuron--Methy sodium 2 g/l | Sullfonylurea | 400 g/ha + 125 ml surface agent | Broad and Narrow leaved weeds |
| Pallas | Pyroxsulam | Triazolopyrimidine sulfonamide | 500 ml/ha | |

## 3. Results and Discussion

*3.1. Narrow Weeds Number (weed m$^{-2}$)*

Table (2) showed effect of herbicides on number of Narrow-leaved weeds at the Tilkaif location. All herbicides used in the study significantly superiority at "control" treatment, which reached highest weeds No. at (8.333) weed/m$^{-2}$. The treatment with Spotlight+Clodia achieved the minimum value weeds No. at 1.875 weed/m$^{-2}$, while the Reward treatment had the highest number at 4.375 weed/m$^{-2}$. In "Bartella", all herbicides also demonstrated superior performance the control, which achieved the peak value weeds No. at 26.833 weed/m$^{-2}$. The "Spotlight+Reward" treatment achieved the minimum value weeds No. at 10.733 weed/m$^{-2}$. The superiority of the "Spotlight+Clodia" treatment in both "Tilkaif" and "Bartella" is likely due to the efficiency of these herbicides when mixed, reducing weed density per unit area. This result may be due to herbicides that contained a more than one chemical substance in their composition are highly effective in reducing weed growth and numbers (Tiwari *et al.* 2015).

The cultivar effects showed that Wafia achieved the minimum value weeds No. at 3.81 weed/m$^{-2}$, not significantly different from "TalAfar3" at the "Tilkaif" location. In "Bartella", Wafia demonstrated superior performance, recording the lowest weeds No. at 12.048 weed/m$^{-2}$, likely due to its efficiency in competing against and suppressing weeds. This attributed may be because of an improvement in the competition of the wheat crop, which in turn leads to a reduction in its density and variations in its growth behavior (Mefleh *et al*. 2019).

The interaction between herbicides and cultivars at the "Tilkaif" location showed that the "Spotlight+Clodia" treatment with Wafia achieved the minimum value weeds No. at 1.667 weed/m$^{-2}$. In "Bartella", the same treatment achieved the minimum value weeds No. at 4.6 weed/m$^{-2}$. This results due to the mixture of herbicides treatments had a significantly inhibit the weed's growth, and then decreasing its density and increase its efficiency in control (Raj *et al.* 2020).

Table (2) Effect of Herbicides, Cultivars and its' interaction on Narrow Weeds No. (weed m$^{-2}$) for both "Telkaif" and "Bartella" Locations.

| **TalKaif** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Cultivars** | Control | Atlants | Pallas | Reward | Spotlight | Spotlight +Clodia | Spotlight +Reward | **Means of Cultivars** |
| Tal Afar3 | 8.75 | 4.583 | 3.75 | 4.583 | 2.5 | 2.083 | 2.083 | 4.048 |
| Wafia | 7.917 | 3.75 | 3.333 | 4.167 | 2.917 | 1.667 | 2.917 | 3.81 |
| **Means of Herb.** | 8.333 | 4.167 | 3.542 | 4.375 | 2.708 | 1.875 | 2.5 | 3.929 |
| **L.S.D.** | **Cultivars 2.954** | | **Herbicides 1.631** | | **Cultivar×Herb. 2.534** | | | |
| **Bartella** | | | | | | | | |
| Tal Afar3 | 33.733 | 18.4 | 16.867 | 16.867 | 30.667 | 18.4 | 13.8 | 21.248 |
| Wafia | 19.933 | 16.867 | 9.2 | 13.8 | 12.267 | 4.6 | 7.667 | 12.048 |
| **Means of Herb.** | 26.833 | 17.633 | 13.033 | 15.333 | 21.467 | 11.5 | 10.733 | 16.648 |
| **L.S.D.** | **Cultivars 4.599** | | **Herb. 3.724** | | **Cultivar×Herb. 5.45** | | | |

*3.2. Broad Weeds Number (weed m$^{-2}$)*

The data presented in Table (3) show herbicides effect on broad-leaved weeds No. at the "Tilkaif" location. All herbicide treatments demonstrated superior performance the control, which achieved the peak value weeds No. at (28.333) weed/m$^{-2}$. The treatments with "Pallas" and "Spotlight+Reward" both achieved the minimum value weeds number at (6.67) weed/m$^{-2}$. In Bartella, the control treatment achieved the peak value weeds No. at (79.35) weed/m$^{-2}$, while the "Spotlight+Reward" treatment achieved the minimum value number at (18.4) weed/m$^{-2}$. the herbicides with more than one chemical in their composition may be causes a highly efficient at weeds (Tiwari *et al.* 2015).

Regarding cultivar effects at "Tilkaif", there were no notable variations between the cultivars. However, at "Bartella", the "TalAfar3" cultivar demonstrated superior performance and achieved the minimum value weeds No. at 30.886 weed/m$^{-2}$. Where the biomass accumulation in wheat varieties is closely and negatively related with weed biomass indicating the potential competitiveness of the crop against the weeds, and it has previously been shown that early crop activity is associated with rapid growth and canopy efficiency, (Mwendwa *et al.* 2020).

The interaction between herbicides and cultivars at the "Tilkaif" location showed that both "Spotlight+Reward" and "Pallas" treatments with both cultivars recorded the same lowest average of (6.667) weed/m$^{-2}$. In Bartella, the

"Spotlight+Reward" treatment with the "TalAfar3" cultivar achieved the minimum value weeds No. at (10.733) weed/$m^2$, while the "control" treatment with the "Wafia" cultivar achieved the peak value number at (94.3) weed/$m^2$. This is consistent with what was stated by (Wahab and Aljuburi 2023) that systemic herbicides, which are transmitted within the plant by xylem and phloem, lead to inhibits of physiological activities within the plant and thus stop the division of cells, and all these factors lead to plant death.

Table (3) Effect of Herbicides, Cultivars and its' interaction on Broad Weeds No. (weed $m^{-2}$) for both "Telkaif" and "Bartella" Locations.

| | | | | | **TalKaif** | | | |
|---|---|---|---|---|---|---|---|---|
| **Cultivars** | Control | Atlants | Pallas | Reward | Spotlight | Spotlight +Clodia | Spotlight +Reward | **Means of Cultivars** |
| Tal Afar3 | 25 | 10 | 6.667 | 10 | 13.333 | 10 | 6.667 | 11.667 |
| Wafia | 31.667 | 8.333 | 6.667 | 13.333 | 8.333 | 11.667 | 6.667 | 12.381 |
| **Means of Herb.** | 28.333 | 9.167 | 6.667 | 11.667 | 10.833 | 10.833 | 6.667 | 12.024 |
| **L.S.D.** | **Cultivars 5.323** | | **Herbicides 7.032** | | **Cultivar*Herb. 7.834** | | | |
| | | | | | **Bartella** | | | |
| Tal Afar3 | 64.4 | 18.4 | 32.2 | 49.067 | 16.867 | 24.533 | 10.733 | 30.886 |
| Wafia | 94.3 | 30.667 | 23 | 52.133 | 38.333 | 23 | 26.067 | 41.071 |
| **Means of Herb.** | 79.35 | 24.533 | 27.6 | 50.6 | 27.6 | 23.767 | 18.4 | 35.979 |
| **L.S.D.** | **Cultivars 7.882** | | **Herb. 9.7** | | **Cultivar×Herb. 10.943** | | | |

*3.3. Narrow Weeds Weight (g. $m^{-2}$)*

The data presented in Table (4) for the "Tilkaif" location show significant differences between the herbicides used in the study. All herbicide treatments demonstrated superior performance the "control", which achieved the peak value weed weight at (9.18) g/m². The "Atlants" treatment achieved the minimum value average weed weight at (4.56) g/m². In Bartella, all herbicide treatments also demonstrated superior performance the "control", which achieved the peak value average weed weight at (42.84) g/m². The "Spotlight+Reward" treatment achieved the minimum value weed weight at (21.56) g/m². This results were consistent with what Al-Mashhadani (2020) found that the reason for this is due to the specialized herbicides in combating both narrow and broad weeds and their efficiency; Thus, this systemic herbicide, which hinders the functioning of the vital and physiological processes of the weed and then stopping its growth and elimination.

The cultivar effects showed no notable variations between the cultivars used in the study at both locations. This is consistent with what (Angel et al. 2016) reported in the varietal competitiveness study that there is no significant difference between varieties in limiting bush growth.

The interaction between herbicides and cultivars at the "Tilkaif" location showed that the "Atlants" herbicide with the "Wafia" cultivar achieved the minimum value weed weight at (4.4) g/m², while the control treatment with the same cultivar achieved the peak value weed weight at (9.84) g/m². In Bartella, the "Spotlight+Clodia" treatment with the "Wafia" cultivar achieved the minimum value average weed weight at (20.868) g/m², while the control treatment with the same cultivar achieved the peak value weed weight at (49.716) g/m². This results may be attributed to the herbicide "Atlants" included of mesosulfuron + idosulfuron, which is sufficient to inhibit amino acids and form new leaves (Mohammed *et al.* 2016).

Table (4) Effect of Herbicides, Cultivars and its' interaction on Narrow Weeds Weight (g. m-2) for both Telkaif and Bartella Locations.

| | | | | | **TalKaif** | | | |
|---|---|---|---|---|---|---|---|---|
| **Cultivars** | Control | Atlants | Pallas | Reward | Spotlight | Spotlight +Clodia | Spotlight +Reward | **Means of Cultivars** |
| Tal Afar3 | 8.52 | 4.72 | 4.08 | 7.52 | 7.2 | 6.24 | 4.56 | 6.12 |
| Wafia | 9.84 | 4.4 | 5.32 | 7.48 | 7.84 | 6.52 | 4.6 | 6.571 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Means of Herb.** | 9.18 | 4.56 | 4.7 | 7.5 | 7.52 | 6.38 | 4.58 | 6.346 |
| **L.S.D.** | **Cultivars** | | **Herbicides** | | **Cultivar*Herb.** | | | |
| | **3.199** | | **2.012** | | **2.892** | | | |
| | | | | **Bartella location** | | | | |
| Tal Afar3 | 35.964 | 25.464 | 23.964 | 25.164 | 26.556 | 21.444 | 24.156 | 26.102 |
| Wafia | 49.716 | 22.188 | 23.148 | 21.192 | 23.172 | 20.868 | 22.668 | 26.136 |
| **Means of Herb.** | 42.84 | 23.826 | 23.556 | 23.178 | 24.864 | 21.156 | 23.412 | 26.119 |
| | **Cultivars** | | **Herb.** | | **Cultivar×Herb.** | | | |
| **L.S.D.** | **4.225** | | **4.438** | | **5.22** | | | |

*3.4. Broad Weeds Weight (g. m$^{-2}$)*

The data presented in Table (5) for the "Tilkaif" location show significant differences between the herbicides are used. All herbicides demonstrated superior performance the "control", which achieved the peak value dry weed weight at (60.64) g/m². The "Spotlight+Reward" treatment achieved the minimum value weed weight at (30.88) g/m². In Bartella, all herbicides also demonstrated superior performance the "control", which achieved the peak value weed weight at (88.196) g/m², while the "Spotlight+Reward" treatment achieved the minimum value weed weight at (24.702) g/m². This result may be because herbicides contained more than one chemical substance in their composition are very efficient in inhibiting weed growth (Aljuburi and Anter 2021).

The cultivars effects in "Tilkaif" location showed that the "Wafia" cultivar demonstrated superior performance, recording the lowest weed weight at (32.395) g/m². In Bartella, there were no notable variations between the cultivars. The reason for the superiority of the variety "Wafia" and rapidly growth of as well as its canopy, and this is consistent with what stated by (Arshad *et al.* 2021) that the growth rapidly is the achievement of closed canopy, which is the general mechanism for improving the competition of grain crops for different weed species.

The interaction between herbicides and cultivars showed that "Spotlight+Reward" treatment with the "Wafia" cultivar achieved the minimum value weed weight at (26.56) g/m² and (22.98) g/m² at "Tilkaif" and "Bartella" locations respectively. The "control" treatment with the "TalAfar3" cultivar achieved the peak value weed weight at (79.792) g/m² in "Tilkaif" location, while "control" with the "Wafia" cultivar achieved the peak value average weed weight at (94.899) g/m² in Bartella location.

Table (5) Effect of Herbicides, Cultivars and its' interaction on Broad Weeds Weight (g. m-2) for both Telkaif and Bartella Locations.

| | | | | **TalKaif** | | | | |
|---|---|---|---|---|---|---|---|---|
| **Cultivars** | Control | Atlants | Pallas | Reward | Spotlight | Spotlight +Clodia | Spotlight +Reward | **Means of Cultivars** |
| Tal Afar3 | 79.792 | 40.688 | 47.76 | 57.088 | 39.056 | 41.568 | 35.2 | 48.736 |
| Wafia | 41.488 | 34.624 | 31.392 | 31.36 | 32.336 | 29.008 | 26.56 | 32.395 |
| **Means of Herb.** | 60.64 | 37.656 | 39.576 | 44.224 | 35.696 | 35.288 | 30.88 | 40.566 |
| **L.S.D.** | **Cultivars** | | **Herbicides** | | **Cultivar*Herb.** | | | |
| | **6.585** | | **6.989** | | **9.471** | | | |
| | | | | **Bartella** | | | | |
| Tal Afar3 | 81.492 | 35.1 | 24 | 54.9 | 23.244 | 29.712 | 26.424 | 39.267 |
| Wafia | 94.899 | 25.2 | 30.096 | 51.36 | 36.276 | 26.328 | 22.98 | 41.02 |
| **Means of Herb.** | 88.196 | 30.15 | 27.048 | 53.13 | 29.76 | 28.02 | 24.702 | 40.144 |
| | **Cultivars** | | **Herb.** | | **Cultivar×Herb.** | | | |
| **L.S.D.** | **5.594** | | **7.051** | | **9.325** | | | |

*3.5. Plant Height (cm)*

The results presented in Table (6) show significant differences in plant height due to the herbicides used in the experiment at the Tilkaif location. The Pallas treatment achieved the peak value of plant height at (85.143) cm. In

Bartella, the "Spotlight+Reward" treatment achieved the peak value average plant height at (85.8) cm, while the control treatments achieved the minimum value averages of (62.533) cm and (61.533) cm at Tilkaif and Bartella, respectively. The superior performance of these herbicides is likely due to their efficiency in reducing weed growth and dry weight, providing better growth conditions for the crop plants. The reason may be due to the efficiency of these herbicides in limiting the weeds growth and inhibiting their dry weights and gave a better opportunity for crop plants to grow then increasing in plant height. (Singh *et al*. 2019).

Cultivar effects at Tilkaif showed no notable variations between the cultivars. However, in Bartella, the Wafia cultivar demonstrated superior performance TalAfar3, recording the highest of plant height (77.1) cm.

The interaction between herbicides and cultivars at "Tilkaif" location showed that "Pallas" herbicide with "TalAfar3" achieved the peak value of plant height at (88.853) cm. In Bartella, the "Spotlight+Reward" treatment with "Wafia" achieved the peak value of plant height (89.4) cm, while the "control" treatment with "TalAfar3" achieved the minimum value (62.16) cm and (60.3) cm at "Tilkaif" and "Bartella" locations respectively. Some traits of mixing herbicides molecules have been developed that have very effective at lower doses of broad, and Narrow weed and may be more effective in controlling different weeds (Kumar *et al.* 2020).

Table (6) Effect of Herbicides, Cultivars and its' interaction on plant height (cm) for both Telkaif and Bartella Locations.

| **TalKaif** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Cultivars** | Control | Atlants | Pallas | Reward | Spotlight | Spotlight +Clodia | Spotlight +Reward | **Means of Cultivars** |
| Tal Afar3 | 62.16 | 78.96 | 88.853 | 67.013 | 65.147 | 77.84 | 80.36 | 74.333 |
| Wafia | 62.907 | 75.88 | 81.433 | 63.933 | 63.467 | 81.9 | 80.547 | 72.867 |
| **Means of Herb.** | 62.533 | 77.42 | 85.143 | 65.473 | 64.307 | 79.87 | 80.453 | 73.6 |
| **L.S.D.** | **Cultivars 14.01** | | **Herbicides 8.43** | | **Cultivar*Herb. 13.60** | | | |
| **Bartella** | | | | | | | | |
| Tal Afar3 | 60.3 | 79.1 | 76.8 | 68.6 | 63.6 | 82.05 | 82.2 | 73.236 |
| Wafia | 63.55 | 80.8 | 85.6 | 68.85 | 64.7 | 86.8 | 89.4 | 77.1 |
| **Means of Herb.** | 61.925 | 79.95 | 81.2 | 68.725 | 64.15 | 84.425 | 85.8 | 75.168 |
| **L.S.D.** | **Cultivars 2.109** | | **Herb. 6.664** | | **Cultivar×Herb. 8.062** | | | |

*3.6. Number of Spikes (spikes m$^{-2}$)*

The results presented in Table (7) show significant differences in the number of spikes due to the herbicides used. The "Spotlight+Reward" treatment achieved the peak value of spikes number (333.6 and 321.667) spikes/m2 at "Tilkaif" and "Bartella" locations respectively, while "control" treatments achieved the minimum value (323.8 and 229.167) spikes/m2 at "Tilkaif" and "Bartella" locations respectively. This is consistent with what was stated by (Al-Mitrafi *et al.* 2014) that the use of (diclofop-methyl + tribneuron-methyl) herbicides gave an opportunity for better growth for wheat plants and the formation of a larger tillers number and thus an increase in the number of spikes per unit area.

Cultivar effects showed significant differences between the cultivars. The "Wafia" cultivar demonstrated superior performance "TalAfar3", recording the highest value (319.543 and 308.155) spikes/m2 at "Tilkaif" and "Bartella" locations respectively. The efficiency of "Wafia" to formation a larger number of effective tillers may be a reason of gave a larger number of spikes per unit area in addition to its efficiency in competing with weeds plants.

The interaction between herbicides and cultivars at "Tilkaif" showed that the "Spotlight+Reward" treatment with "Wafia" achieved the peak value of spikes number at (380.8) spikes/m2. In Bartella, the "Pallas" herbicide with "Wafia" achieved the peak value of number of spikes at (348.75) spikes/m2, while the "control" treatment with "TalAfar3" achieved the minimum value (225.6 and 200) spikes/m2 at "Tilkaif" and "Bartella" locations respectively.

Table (7) Effect of Herbicides, Cultivars and its' interaction on Spikes No. (spikes m-2) for both Telkaif and Bartella Locations.

| **TalKaif** |
|---|

| **Cultivars** | Control | Atlants | Pallas | Reward | Spotlight | Spotlight +Clodia | Spotlight +Reward | **Means of Cultivars** |
|---|---|---|---|---|---|---|---|---|
| Tal Afar3 | 225.6 | 260.8 | 270.4 | 251.2 | 272 | 264 | 286.4 | 261.486 |
| Wafia | 240 | 283.2 | 336 | 281.6 | 340.8 | 374.4 | 380.8 | 319.543 |
| **Means of Herb.** | 232.8 | 272 | 303.2 | 266.4 | 306.4 | 319.2 | 333.6 | 290.514 |
| **L.S.D.** | **Cultivars 12.64** | | **Herbicides 23.73** | | **Cultivar*Herb. 27.86** | | | |
| | | | | **Bartella** | | | | |
| Tal Afar3 | 200 | 256.667 | 286.667 | 221.67 | 285 | 280 | 308.333 | 262.619 |
| Wafia | 258.333 | 328.333 | 348.75 | 275 | 310 | 301.667 | 335 | 308.155 |
| **Means of Herb.** | 229.167 | 292.5 | 317.708 | 248.33 | 297.5 | 290.833 | 321.667 | 285.387 |
| **L.S.D.** | **Cultivars 8.43** | | **Herb. 24.62** | | **Cultivar×Herb. 34.26** | | | |

*3.7. Weight of 1000 Grains (g)*

The data presented in Table (8) show significantly differences in the 1000 grains weight due to the herbicides used in this study. At "Tilkaif", the "Spotlight+Reward" treatment achieved the peak value average weight of 1000 grains at (35.024) g. In Bartella, "Pallas" herbicide achieved the peak value of weight of 1000 grains at (36.719) g, while the "control" treatments achieved the minimum value (26.414) g and (26.873) g at "Tilkaif" and "Bartella" locations respectively. The reason for this may be attributed to the decrease in weed number and its weight while using the (Spotlight + Reward) treatment, and this was reflected on the efficiency of photosynthesis processes and then increasing in processed dry matter that may transferred to the grains and leads to an increase in the weight of 1000 grains (ALJUBURI and ANTER 2021) .

Cultivar effects for the weight of 1000 grains showed that at "Tilkaif" location, the "Wafia" cultivar demonstrated superior performance "TalAfar3", recording the highest value of weight at (32.09) g. In Bartella, there were no notable variations between "TalAfar3" and "Wafia".

The interaction between herbicides and cultivars at "Tilkaif" location showed that the "Spotlight+Reward" treatment with "Wafia" achieved the peak value of weight of 1000 grains at (36.692) g, while the "control" treatment with "TalAfar3" achieved the minimum value of weight at (25.252) g. In Bartella, the "Spotlight+Reward" treatment with "TalAfar3" achieved the peak value average weight at 37.904 g, while the control treatment with Wafia achieved the minimum value average weight at 26.368 g.

Table (8) Effect of Herbicides, Cultivars and its' interaction on 1000 grains weight for both Telkaif and Bartella Locations.

| | | | | **TalKaif** | | | | |
|---|---|---|---|---|---|---|---|---|
| **Cultivars** | Control | Atlants | Pallas | Reward | Spotlight | Spotlight +Clodia | Spotlight +Reward | **Means of Cultivars** |
| Tal Afar3 | 25.252 | 26.732 | 35.792 | 27.728 | 31.548 | 30.38 | 33.356 | 30.113 |
| Wafia | 27.576 | 29.732 | 33.896 | 31.964 | 31.156 | 33.612 | 36.692 | 32.09 |
| **Means of Herb.** | 26.414 | 28.232 | 34.844 | 29.846 | 31.352 | 31.996 | 35.024 | 31.101 |
| **L.S.D.** | **Cultivars 1.873** | | **Herbicides 5.092** | | **Cultivar*Herb. 7.622** | | | |
| | | | | **Bartella** | | | | |
| Tal Afar3 | 27.108 | 31.658 | 35.654 | 36.108 | 28.713 | 33.038 | 37.904 | 32.883 |
| Wafia | 26.638 | 34.233 | 37.783 | 31.717 | 31.879 | 36.592 | 34.517 | 33.337 |
| **Means of Herb.** | 26.873 | 32.946 | 36.719 | 33.913 | 30.296 | 34.815 | 36.21 | 33.11 |
| **L.S.D.** | **Cultivars 5.749** | | **Herb. 4.107** | | **Cultivar×Herb. 6.411** | | | |

*3.8. Grain Yield (g $m^{-2}$)*

The table (9) presented significant differences in grain yield due to the herbicides used in the study. The "Spotlight+Reward" treatment achieved the peak value grain yield at (312.693) g/m² and (234.657) g/m² at "Tilkaif" and "Bartella" locations respectively, while the control treatments achieved the minimum value averages at (127.318, and 100.12) g/m² at "Tilkaif" and "Bartella" locations respectively. The reason may be due to attributed to efficiency of these herbicides in combating the weed and reducing its growth and thus providing moisture, nutrients and light, which led to increasing the efficiency of the photosynthesis process and increasing its productions, which contribute significantly to increasing in leaves area and thus increasing the accumulation of dry matter, then increasing the spikes number and weight grains and thus increasing the yield, and this is confirmed by (Soliman and Hamza, 2015).

Cultivar effects for grain yield at "Tilkaif" showed no notable variations between the cultivars. However, "Wafia" cultivar demonstrated superior performance "TalAfar3", recording the highest grain yield at (234.946, and 214.214) g/m² at "Tilkaif" and "Bartella" locations respectively.

The interaction between herbicides and cultivars at Tilkaif showed that the "Spotlight+Reward" treatment with "Wafia" achieved the peak value of grain yield (382.282) g/m². In Bartella, "Pallas" herbicide with "Wafia" cultivar achieved the peak value of grain yield (324.359) g/m², while "control" treatment with "TalAfar3" achieved the minimum value (115.601) g/m² and (84.222) g/m² at "Tilkaif" and "Bartella" locations respectively. The excellence and efficiency of these herbicides in the weed control may be a reason of this significant as well as the mixing agents containing chemicals that are more effective in weed control (Evans et al. 2016; Lamichhane et al. 2016).

Table (8) Effect of Herbicides, Cultivars and its' interaction on Grain Yield (g $m^{-2}$) for both Telkaif and Bartella Locations.

| **TalKaif** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Cultivars** | Control | Atlants | Pallas | Reward | Spotlight | Spotlight +Clodia | Spotlight +Reward | **Means of Cultivars** |
| Tal Afar3 | 115.601 | 180.095 | 258.16 | 160.521 | 199.798 | 173.283 | 243.105 | 190.08 |
| Wafia | 139.034 | 175.454 | 261.97 | 209.612 | 211.614 | 264.653 | 382.282 | 234.946 |
| **Means of Herb.** | 127.318 | 177.775 | 260.065 | 185.066 | 205.706 | 218.968 | 312.693 | 212.513 |
| **L.S.D.** | **Cultivars** | | **Herbicides** | | **Cultivar*Herb.** | | | |
| | **14.18** | | **47.78** | | **63.59** | | | |
| **Bartella** | | | | | | | | |
| Tal Afar3 | 84.222 | 132.319 | 186.889 | 138.33 | 132.425 | 163.246 | 200.863 | 148.327 |
| Wafia | 116.019 | 189.868 | 324.359 | 160.08 | 216.511 | 224.209 | 268.451 | 214.214 |
| **Means of Herb.** | 100.12 | 161.093 | 255.624 | 149.21 | 174.468 | 193.727 | 234.657 | 181.271 |
| | **Cultivars** | | **Herb.** | | **Cultivar×Herb.** | | | |
| **L.S.D.** | **56.67** | | **39.8** | | **58.26** | | | |

## 4. Conclusions

The herbicide treatments varied in their efficacy in suppressing weed densities and their dry weights, in addition to affecting yield traits and components compared to the control at both study locations. The combined treatment of Spotlight + Reward had the most significant impact on most studied traits. This effect is likely because the combination of herbicides broke the resistance of weeds to the treatments. Additionally, the Wafia cultivar outperformed the Tal Afar3 cultivar in most of the studied traits.

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